

CLAIMS

What is claimed is:

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1. A compound having the formula:



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wherein  $R_1$  is selected from the group consisting of alkyl, substituted alkyl, aralkyl, substituted aralkyl, aryl, and substituted aryl;  $R_2$  is selected from the group consisting of H, OH, or alkoxy, aralkoxy, aryloxy;  $R_3$  is selected from the group consisting of OH, CEPA, oligonucleotide and hydroxyl blocking group;  $R_4$  is selected from the group consisting of OH, oligonucleotide and hydroxyl blocking group; B is a nucleoside base; X is selected from the group consisting of O and  $CH_2$ ;

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wherein any alkyl portion of  $R_1$  and  $R_2$  is C1 to C10 linear or branched; and

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wherein any aryl portion of  $R_1$  and  $R_2$  is a phenyl or a heterocycle.

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2. The compound of claim 1, wherein  $R_1$  is selected from the group consisting of cyanoalkyl, cyanoaryl, and cyanoaralkyl.

3. The compound of claim 1 wherein  $R_1$  is selected from the group consisting of nitroalkyl, nitroaryl, and nitroaralkyl.

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4. The compound of claim 1 in which  $R_1$  is an amino derivative of the form  $X_1X_2NR$ , where  $X_1$  is selected from the group consisting of H, methyl, ethyl, Ac, and  $CF_3CO$ ;  $X_2$  is selected from the group consisting of H, methyl, ethyl, Ac, and  $CF_3CO$ ; and R is a linker that can be an alkyl, aralkyl or aryl.

5. The compound of claim 1 wherein  $R_1$  is selected from the group consisting of hydroxyalkyl, hydroxyaryl, and hydroxyaralkyl, wherein anyl alkyl portion is C2-C8.

6. The compound of claim 1 in which  $R_1$  is selected from the group consisting of alkoxyalkyl, alkoxyaralkyl, aryloxyalkyl, aryloxyaralkyl, aralkoxyalkyl, aralkoxyaralkyl, and aryloxy.

7. The compound of claim 1 in which  $R_1$  is XSR, where X is selected from the group consisting of H, Ac,  $CF_3CO$ , alkyl, aryl, and aralkyl; R is a linker that can be an alkyl, aralkyl, or aryl.

8. The compound of claim 1 in which  $R_1$  is an amide derivative of the form  $X_1X_2NCOR$ , where  $X_1$  is H or alkyl;  $X_2$  is H or alkyl; R is a linker that can be alkyl, aralkyl, or aryl.

9. The compound of claim 1 in which  $R_1$  is  $XOOCR$ , where X is selected from H, alkyl, aralkyl, and aryl; R is a linker that can be alkyl, aralkyl, or aryl.

10. The compound of claim 1 in which  $R_1$  is XR, where X is selected from the group consisting of F, Cl, Br, I, OTs,  $N_3$ ; R is a linker that can be alkyl, aralkyl, or aryl.

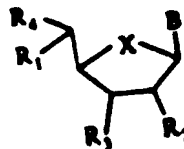
11. The compound of claim 1 in which  $R_1$  is selected from the group consisting of alkyl, aralkyl, aryl, alkenyl, aralkenyl, where any alkyl portion is C1-C10 linear or branched, where any alkenyl portion is C2-C10 linear or branched, and where any aryl portion is a phenyl or a heterocycle.

12. The compound of claim 1 in which  $R_1$  is selected from the

PATENT  
213/001

group consisting of CN, NO<sub>2</sub>, N<sub>3</sub>, and CF<sub>3</sub>.

13. A compound having the formula:



wherein R<sub>1</sub> is selected from the group consisting of H, alkyl, substituted alkyl, aralkyl, substituted aralkyl, aryl, substituted aryl; R<sub>2</sub> is selected from the group consisting of H, hydroxyl, alkoxy, aralkoxy, and aryloxy; R<sub>3</sub> is selected from the group OH, oligonucleotide and CEPA; R<sub>4</sub> is selected from the group consisting of OH, oligonucleotide and DMTrO; B is a nucleoside base; X is selected from the group consisting of O, and CH<sub>2</sub>;

wherein any alkyl portion of R<sub>1</sub> and R<sub>2</sub> is C1-C8 linear or branched, and any aryl portion of R<sub>1</sub> and R<sub>2</sub> is a phenyl or heterocycle; and

wherein the carbon attached to both R<sub>1</sub> and R<sub>2</sub> has either R or S configuration.

14. The compound of claim 13, wherein R<sub>1</sub> is selected from the group consisting of cyanoalkyl, cyanoaryl, and cyanoaralkyl.

15. The compound of claim 13 wherein R<sub>1</sub> is selected from the group consisting of nitroalkyl, nitroaryl, and nitroaralkyl.

16. The compound of claim 13 in which R<sub>1</sub> is an amino derivative of the form X<sub>1</sub>X<sub>2</sub>NR, where X<sub>1</sub> is selected from the group consisting of H, methyl, ethyl, Ac, and CF<sub>3</sub>CO; X<sub>2</sub> is selected from the group consisting of H, methyl, ethyl, Ac, and CF<sub>3</sub>CO; and R is a linker that can be an alkyl, aralkyl or aryl.

17. The compound of claim 13 wherein R<sub>1</sub> is selected from the

PATENT  
213/001-CIP

group consisting of hydroxyalkyl, hydroxyaryl, and hydroxyaralkyl, wherein any alkyl portion is C1-C8.

5 18. The compound of claim 13 in which  $R_1$  is selected from the group consisting of alkoxyalkyl, alkoxyaralkyl, aryloxyalkyl, aryloxyaralkyl, aralkoxyalkyl, aralkoxyaralkyl, and aryloxy.

10 19. The compound of claim 13 in which  $R_1$  is XSR, where X is selected from the group consisting of H, Ac,  $CF_3CO$ , alkyl, aryl, and aralkyl; R is a linker that can be an alkyl, aralkyl, or aryl.

15 20. The compound of claim 13 in which  $R_1$  is an amide derivative of the form  $X_1X_2NCOR$ , where  $X_1$  is H or alkyl;  $X_2$  is H or alkyl; R is a linker that can be alkyl, aralkyl, or aryl.

20 21. The compound of claim 13 in which  $R_1$  is  $XOOCR$ , where X is selected from H, alkyl, aralkyl, and aryl; R is a linker that can be alkyl, aralkyl, or aryl.

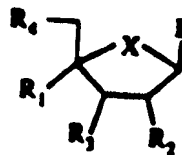
22. The compound of claim 13 in which  $R_1$  is XR, where X is selected from the group consisting of F, Cl, Br, I, OTs,  $N_3$ ; R is a linker that can be alkyl, aralkyl, or aryl.

25 23. The compound of claim 13 in which  $R_1$  is selected from the group consisting of alkyl, aralkyl, aryl, alkenyl, aralkenyl, where any alkyl portion is C2-C10 linear or branched, where any alkenyl portion is C2-C10 linear or branched, and where any aryl portion is a phenyl or a heterocycle.

30 24. The compound of claim 13 in which  $R_1$  is selected from the group consisting of CN,  $NO_2$ ,  $N_3$ , and  $CF_3$ .

PATENT  
213/001-CIP

25. A compound having the formula:



where R<sub>1</sub> is selected from the group consisting of H, alkyl, substituted alkyl, aralkyl, substituted aralkyl, aryl, substituted aryl; R<sub>2</sub> is selected from the group consisting of H, hydroxyl, alkoxy, aralkoxy, and aryloxy; R<sub>3</sub> is selected from the group consisting of OH, oligonucleotide and CEPA; R<sub>4</sub> is selected from the group consisting of OH, oligonucleotide and DMTrO; B is a nucleoside base; X is selected from the group consisting of O and CH<sub>2</sub>;

wherein any alkyl portion of R<sub>1</sub> and R<sub>2</sub> is C1-C8 linear or branched, and any aryl portion of R<sub>1</sub> and R<sub>2</sub> is a phenyl or heterocycle.

26. The compound of claim 25, wherein R<sub>1</sub> is selected from the group consisting of cyanoalkyl, cyanoaryl, and cyanoaralkyl.

27. The compound of claim 25 wherein R<sub>1</sub> is selected from the group consisting of nitroalkyl, nitroaryl, and nitroaralkyl.

28. The compound of claim 25 in which R<sub>1</sub> is an amino derivative of the form X<sub>1</sub>X<sub>2</sub>NR, where X<sub>1</sub> is selected from the group consisting of H, methyl, ethyl, Ac, and CF<sub>3</sub>CO; X<sub>2</sub> is selected from the group consisting of H, methyl, ethyl, Ac, and CF<sub>3</sub>CO; and R is a linker that can be an alkyl, aralkyl or aryl.

29. The compound of claim 25 wherein R<sub>1</sub> is selected from the group consisting of hydroxyalkyl, hydroxyaryl, and hydroxyaralkyl, wherein any alkyl portion is C2-C8.

30. The compound of claim 25 in which R<sub>1</sub> is selected from the

group consisting of alkoxyalkyl, alkoxyraralkyl, aryloxyalkyl, aryloxyaralkyl, aralkoxyalkyl, aralkoxyaralkyl, and aryloxy.

31. The compound of claim 25 in which  $R_1$  is XSR, where X is selected from the group consisting of H, Ac,  $CF_3CO$ , alkyl, aryl, and aralkyl; R is a linker that can be an alkyl, aralkyl, or aryl.

32. The compound of claim 25 in which  $R_1$  is an amide derivative of the form  $X_1X_2NCOR$ , where  $X_1$  is H or alkyl;  $X_2$  is H or alkyl; R is a linker that can be alkyl, aralkyl, or aryl.

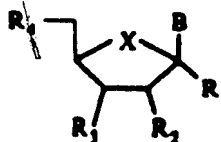
33. The compound of claim 25 in which  $R_1$  is  $XOOCR$ , where X is selected from H, alkyl, aralkyl, and aryl; R is a linker that can be alkyl, aralkyl, or aryl.

34. The compound of claim 25 in which  $R_1$  is XR, where X is selected from the group consisting of F, Cl, Br, I, OTs,  $N_3$ ; R is a linker that can be alkyl, aralkyl, or aryl.

35. The compound of claim 25 in which  $R_1$  is selected from the group consisting of alkyl, aralkyl, aryl, alkenyl, aralkenyl, where any alkyl portion is C1-C10 linear or branched, where any alkenyl portion is C2-C10 linear or branched, and where any aryl portion is a phenyl or a heterocycle.

36. The compound of claim 25 in which  $R_1$  is selected from the group consisting of  $NO_2$  and  $CF_3$ .

37. A compound have the formula:



PATENT  
213/001-CIP

where  $R_1$  is selected from the group consisting of H, alkyl, substituted alkyl, aralkyl, substituted aralkyl, aryl, substituted aryl;  $R_2$  is selected from the group consisting of H, hydroxyl, alkoxy, aralkoxy, and aryloxy;  $R_3$  is selected from the group consisting of OH, oligonucleotide and CEPA;  $R_4$  is selected from the group consisting of OH, oligonucleotide and DMTrO; B is a nucleoside base; X is selected from the group consisting of O and  $CH_2$ ;

wherein any alkyl portion of  $R_1$  and  $R_2$  is C1-C8 linear or branched, and any aryl portion of  $R_1$  and  $R_2$  is a phenyl or heterocycle.

38. The compound of claim 37, wherein  $R_1$  is selected from the group consisting of cyanoalkyl, cyanoaryl, and cyanoaralkyl.

39. The compound of claim 37 wherein  $R_1$  is selected from the group consisting of nitroalkyl, nitroaryl, and nitroaralkyl.

40. The compound of claim 37 in which  $R_1$  is an amino derivative of the form  $X_1X_2NR$ , where  $X_1$  is selected from the group consisting of H, methyl, ethyl, Ac, and  $CF_3CO$ ;  $X_2$  is selected from the group consisting of H, methyl, ethyl, Ac, and  $CF_3CO$ ; and R is a linker that can be an alkyl, aralkyl or aryl.

41. The compound of claim 37 wherein  $R_1$  is selected from the group consisting of hydroxyalkyl, hydroxyaryl, and hydroxyaralkyl, wherein any alkyl portion is C2-C8.

42. The compound of claim 37 in which  $R_1$  is selected from the group consisting of alkoxyalkyl, alkoxyaralkyl, aryloxyalkyl, aryloxyaralkyl, aralkoxyalkyl, aralkoxyaralkyl, and aryloxy.

43. The compound of claim 37 in which  $R_1$  is XSR, where X is

PATENT  
213/001-CIP

selected from the group consisting of H, Ac,  $\text{CF}_3\text{CO}$ , alkyl, aryl, and aralkyl; R is a linker that can be an alkyl, aralkyl, or aryl.

5 44. The compound of claim 37 in which  $R_1$  is an amide derivative of the form  $\text{X}_1\text{X}_2\text{NCOR}$ , where  $\text{X}_1$  is H or alkyl;  $\text{X}_2$  is H or alkyl; R is a linker that can be alkyl, aralkyl, or aryl.

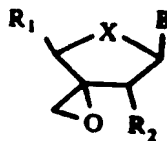
10 45. The compound of claim 37 in which  $R_1$  is  $\text{XOOCR}$ , where X is selected from H, alkyl, aralkyl, and aryl; R is a linker that can be alkyl, aralkyl, or aryl.

15 46. The compound of claim 37 in which  $R_1$  is  $\text{XR}$ , where X is selected from the group consisting of F, Cl, Br, I, OTs,  $\text{N}_3$ ; R is a linker that can be alkyl, aralkyl, or aryl.

20 47. The compound of claim 37 in which  $R_1$  is selected from the group consisting of alkyl, aralkyl, aryl, alkenyl, aralkenyl, where any alkyl portion is C1-C10 linear or branched, where any alkenyl portion is C2-C10 linear or branched, and where any aryl portion is a phenyl or a heterocycle.

25 48. The compound of claim 37 in which  $R_1$  is selected from the group consisting of  $\text{NO}_2$ ,  $\text{N}_3$ , and  $\text{CF}_3$ .

49. A compound having formula:



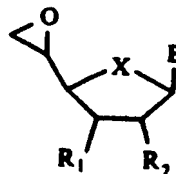
30 where  $R_1$  and  $R_2$  are each selected from the group consisting of  $\text{CH}_2\text{OH}$ ,  $\text{CH}_2\text{ODMTr}$ ,  $\text{CHO}$ ,  $\text{COOH}$ ,  $\text{COOEt}$ ; X is selected from the group consisting of O and  $\text{CH}_2$ ; and B is a nucleoside base; wherein the tertiary carbon of the epoxy group has either R or S



PATENT  
213/001-CIP

configuration.

50. A compound having formula:



where R<sub>1</sub> and R<sub>2</sub> are each selected from the group consisting of CH<sub>2</sub>OH, CH<sub>2</sub>ODMTr, CHO, COOH, COOEt; X is selected from the group consisting of O and CH<sub>2</sub>; and B is a nucleoside base; wherein the tertiary carbon of the epoxy group has either R or S configuration.

51. A polynucleotide comprising at least 2 nucleotide subunits, wherein at least one nucleotide subunit is a compound according to claim 1.

52. A polynucleotide comprising at least 2 nucleotide subunits, wherein at least one nucleotide subunit is a compound according to claim 13.

53. A polynucleotide comprising at least 2 nucleotide subunits, wherein at least one nucleotide subunit is a compound according to claim 25.

54. A polynucleotide comprising at least 2 nucleotide subunits, wherein at least one nucleotide subunit is a compound according to claim 37.

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